

# Non-linear distortion-based effect of tax changes on output: A worldwide narrative approach


Samara Gunter  
*Colby College*

Carlos Vegh  
*World Bank*

Daniel Riera-Crichton  
*Bates College*

Guillermo Vuletin  
*IADB*

# Tax multipliers: Big picture and main source of contention

- **Massive literature on government spending multipliers**
- **Much less work on tax multipliers because of measurement problems**  
Romer and Romer (*AER*, 2010) Riera-Crichton, Vegh, Vuletin (*JME*, 2016) 
- **Main objective:**  
 $\Delta T \rightarrow \Delta Y$
- **Main source of contention:**
  - How to address endogeneity concerns (i.e., identify exogenous tax shocks)
  - Why?  
Because  $\Delta Y \rightarrow \Delta T$  (i.e., cyclicity of tax policy)  
Vegh and Vuletin (*AEJ:EP*, 2015) show that tax policy is a-cyclical in industrial countries and pro-cyclical in developing countries.

# Contributions of this paper

- **We take on this challenge by**

- Building a narrative approach for a global sample focusing on VAT rate changes.

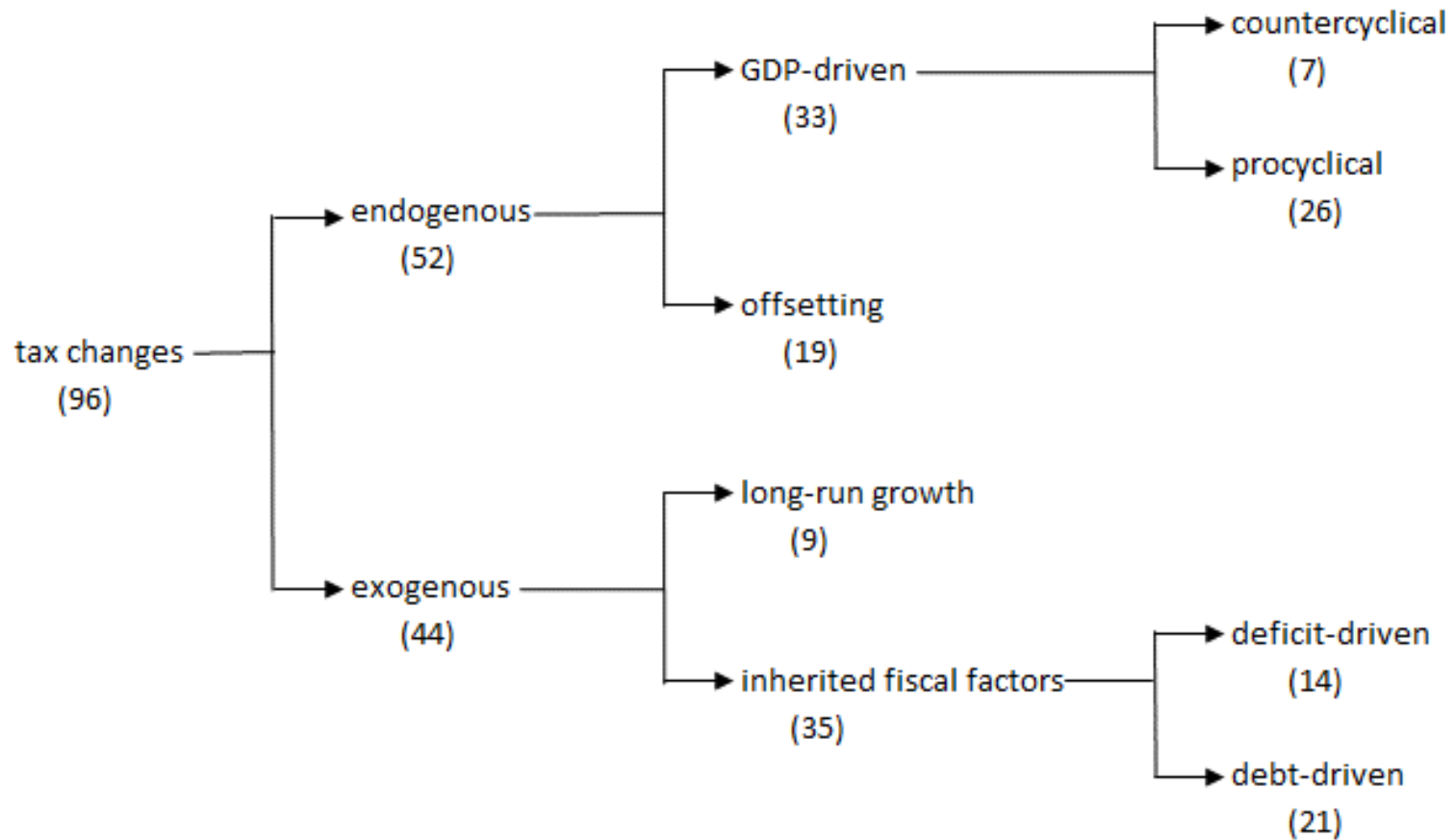
- 51 countries (21 ind. and 30 dev.) for the period 1970-2014, quarterly data.

- Total of 96 tax changes in 35 countries (18 ind. and 17 dev.).

- Sources of narratives: IMF, OECD, domestic records, and news articles.

- Building upon Romer and Romer (2010) strategy and incorporating some new elements based on our global sample and tax measure

# Tax changes: Identifying motivation



# Linear estimations and biases due to misidentifications

- Using Jorda (*AER*, 2005)'s local projections method we, first, estimate:

$$\Delta y_{i,t+h} = \alpha_{i,h} + \beta_h \Delta t_{i,t+h}^{exog} + \lambda_h(L) \Delta y_{i,t-1} + \psi_h(L) \Delta t_{i,t-1}^{all} + \phi_h(L) \Delta g_{i,t-1} + \eta_{t,h} + \mu_{i,t,h},$$

- Second, we use  $\beta_h$  to compute standard tax multiplier at time horizon h:

$$\text{Tax multiplier } (h) \equiv \frac{\Delta Y_{i,t+h}}{\Delta R_{i,t+h}}$$

Specifically,

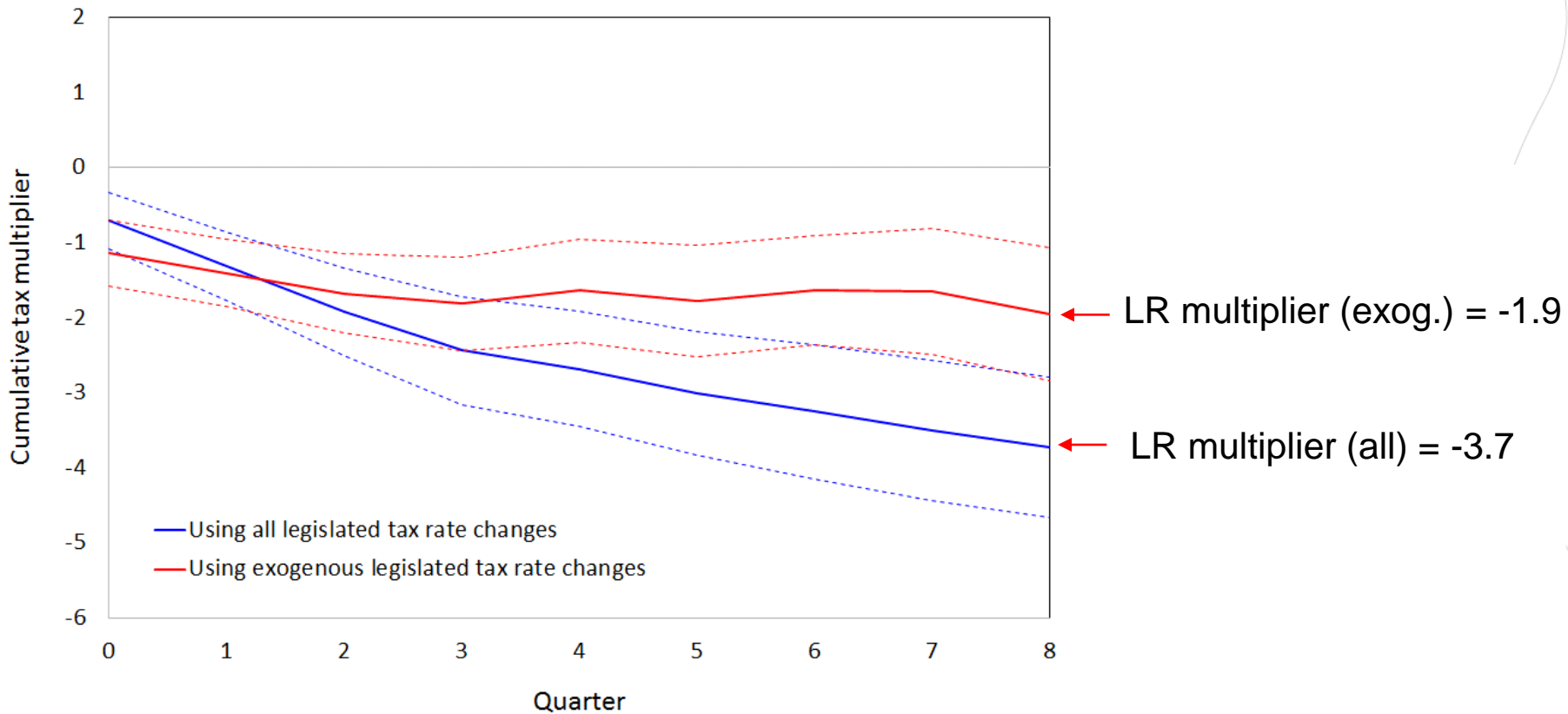
$$\text{Tax multiplier } (h) = \frac{\beta_h}{e + \beta_h \cdot \bar{I}_h}$$

$$\text{Tax multiplier}_{SE} (h) = \frac{e}{(e + \beta_h \cdot \bar{I}_h)^2} \beta_h^{SE}$$

where  $I=R/Y$  and  $e=l/t$ .

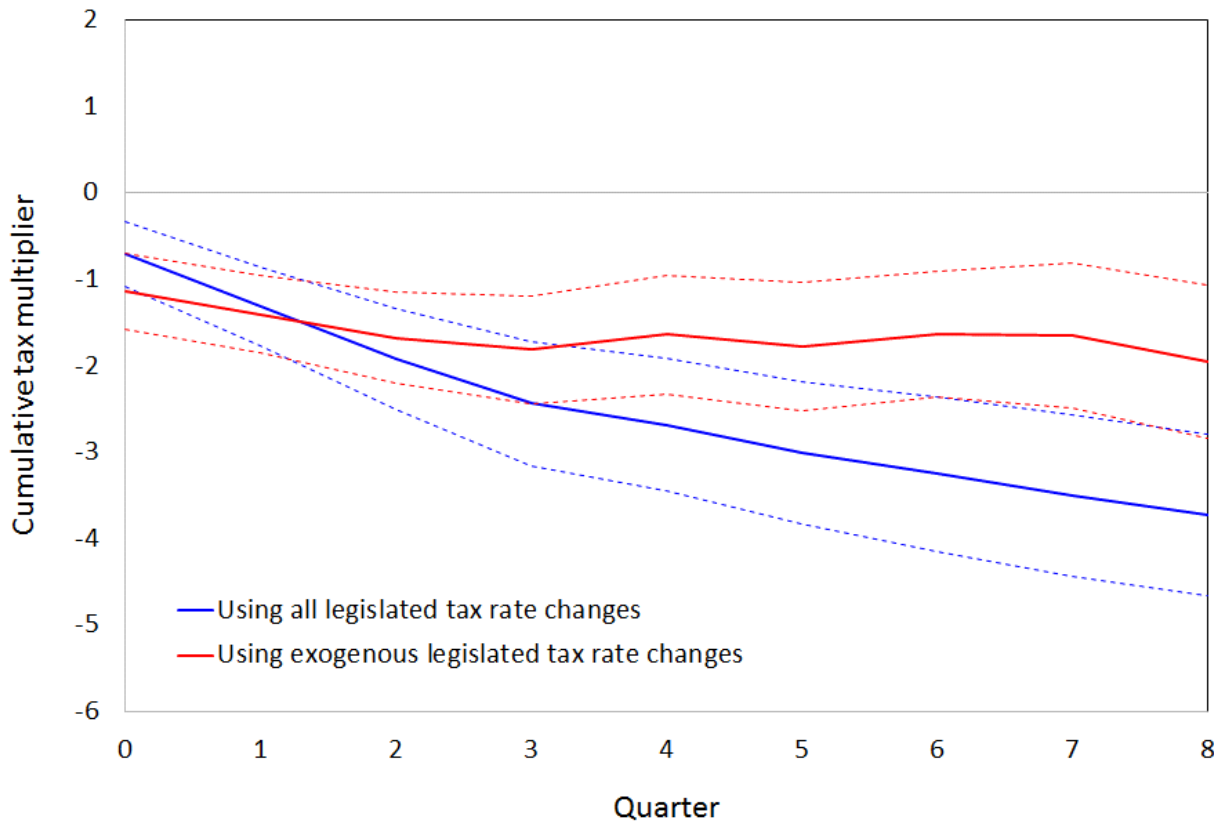
# Linear estimations and biases due to misidentifications

- Main findings:



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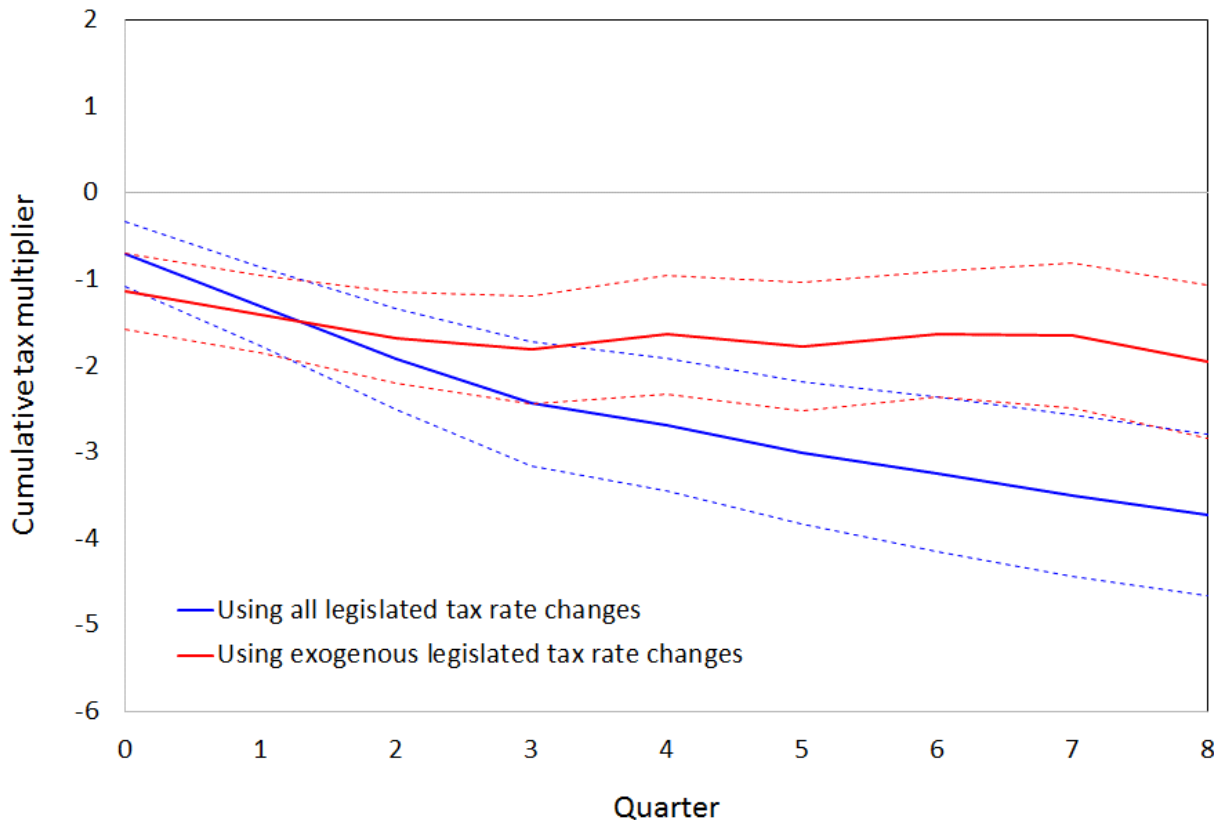
Source of bias?

LR multiplier (exog.) = -1.9

LR multiplier (all) = -3.7

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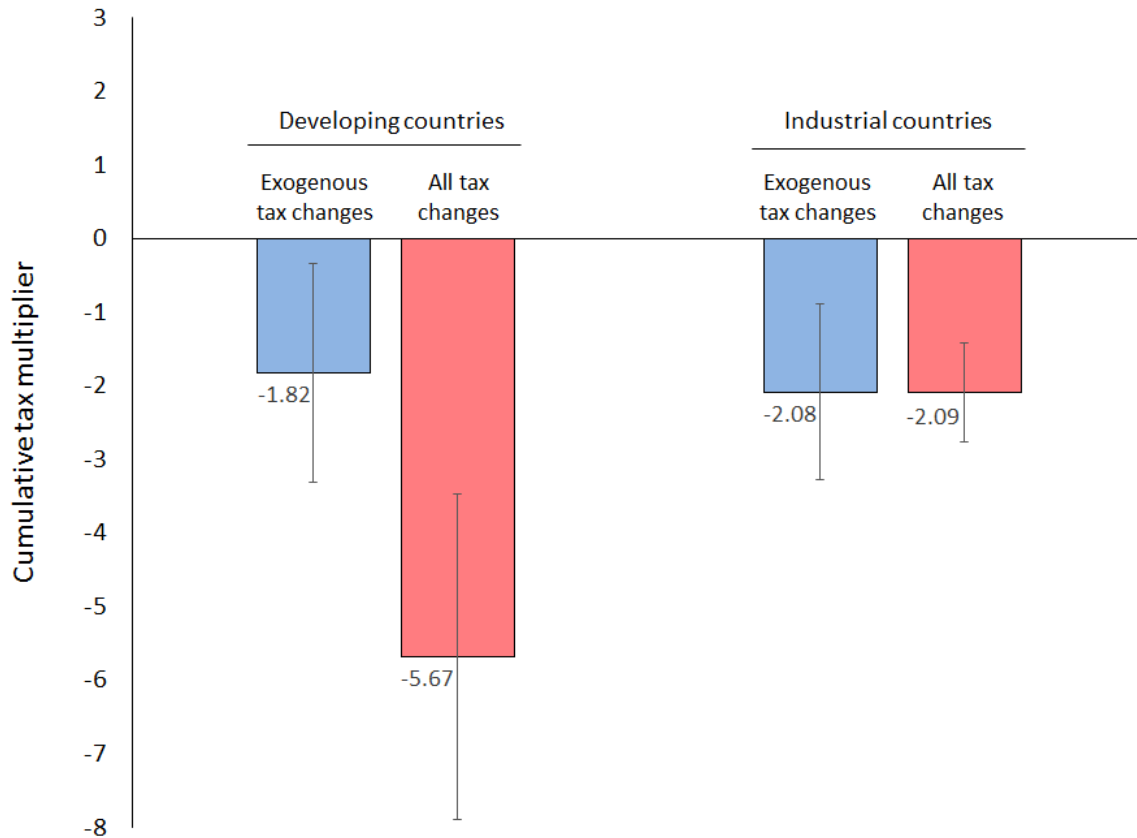
Because of average **pro-cyclical** nature of endogenous tax changes



# Linear estimations and biases due to misidentifications

- **Bias in action I: Industrial vs developing**

- LR-multiplier estimates:



**Finding #1:**  
Multiplier (exog.) in industrial countries is similar to developing one

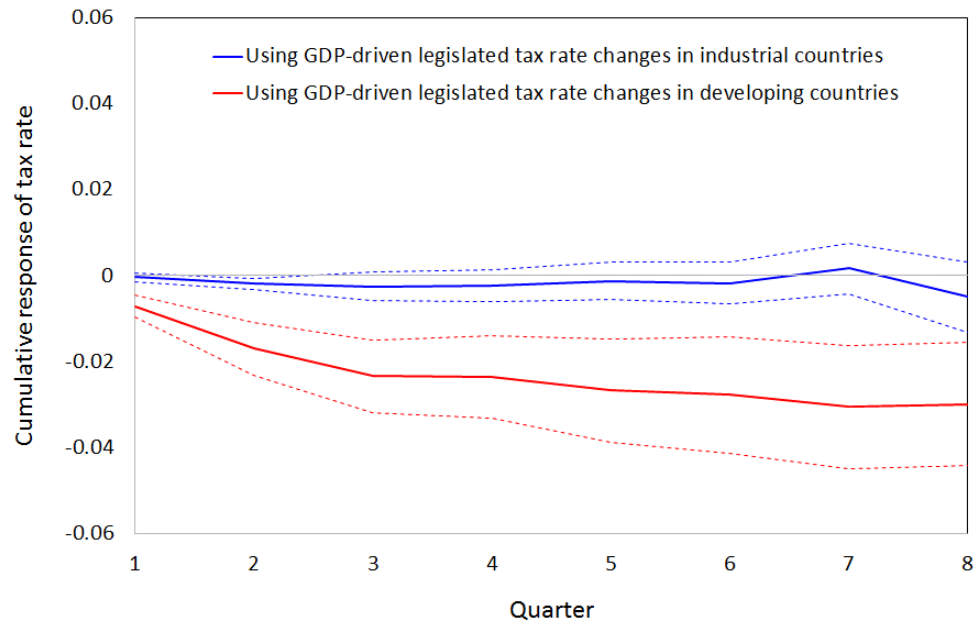
**Finding #2:**  
Bias present in developing world, not in industrial countries.

# Linear estimations and biases due to misidentifications

- **Bias in action I: Industrial vs developing**

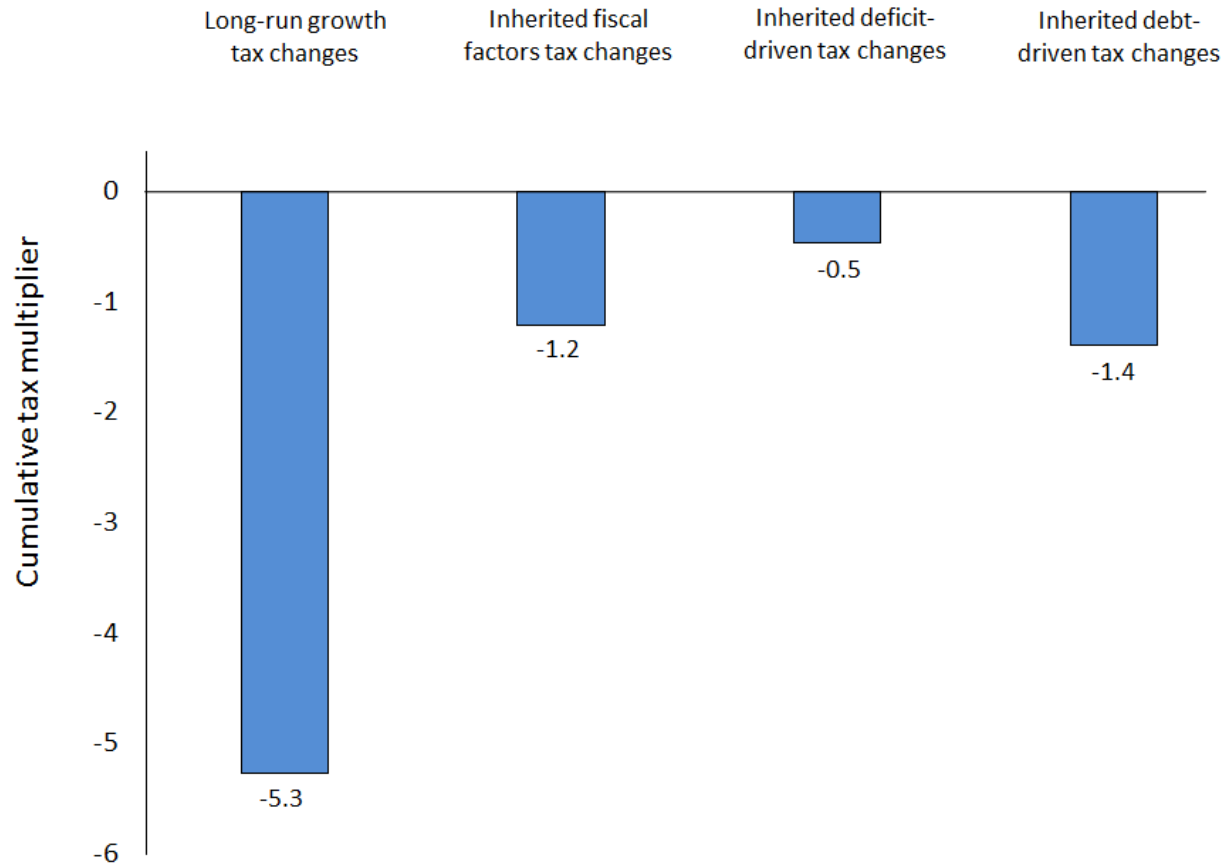
- Why is bias present in developing world and not in industrial countries?

It has to be with endogenous nature of endogenous tax changes



# Differential effects on output of exogenous tax changes

- We obtain similar differential effects (LR-multipliers):



# Differential effects on output of exogenous tax changes

- **There seems to be robust evidence of differential effects of exogenous tax changes on output both in RR's (U.S. only) and for our global sample.**
- **Why?**
  - A possible explanation is, of course, that the mechanism (i.e., model) involved is different
  - While we cannot rule out such considerations, we will argue that a simpler explanation could simply rely on non-linear effects of tax changes on output

# The non-linear effect of tax changes on output

- **Theoretical arguments**

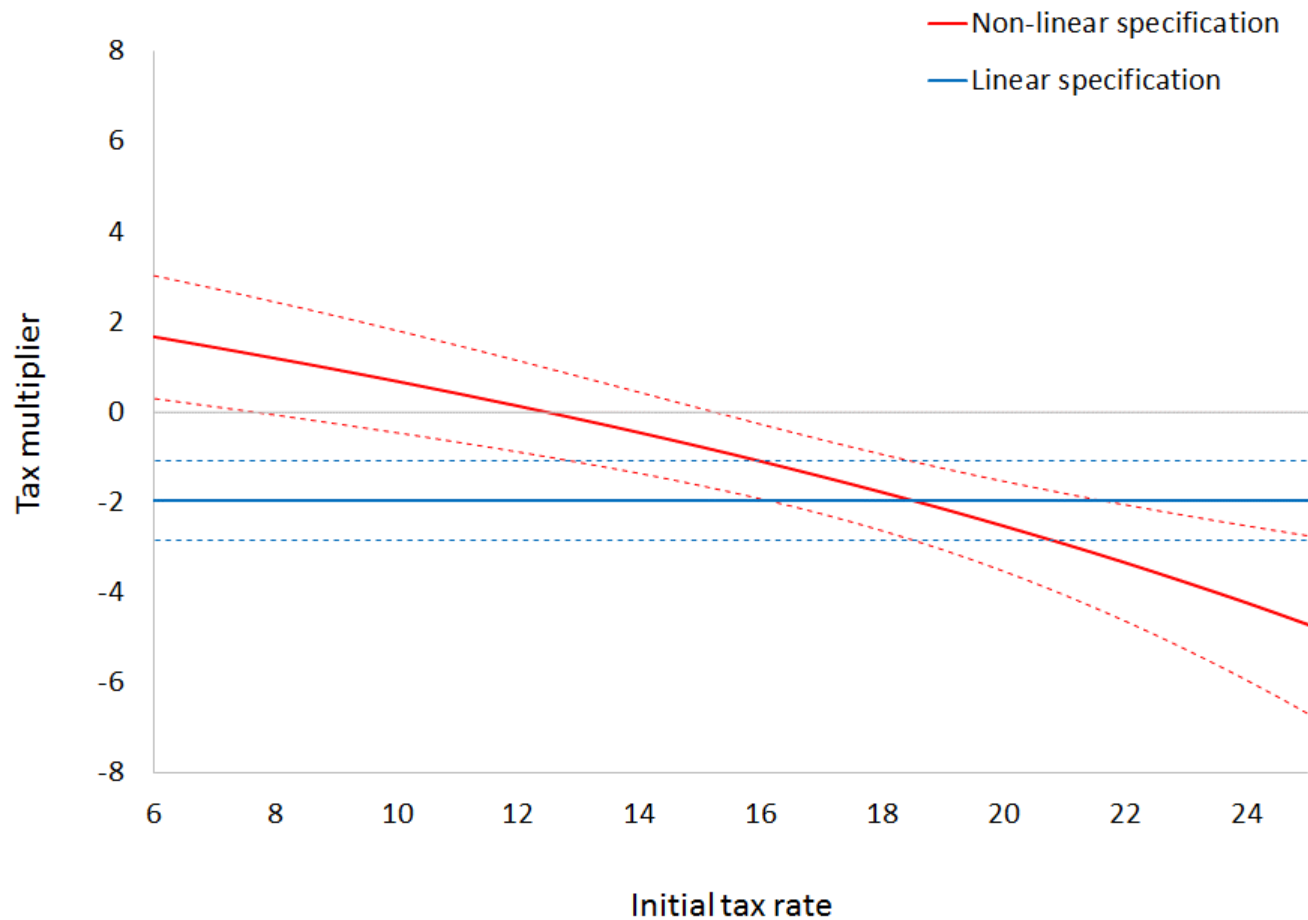
- Jaimovich and Rebelo (*JPE*, 2016) show theoretically that the long-run output effect of tax changes is small at low initial levels of taxation but much larger when initial tax levels are high.

- This is naturally related to a well-established public finance literature (e.g., Harberger, 1964; Browning, 1975; Feldstein, 1995; Hines, 2007) showing that the distortion imposed by taxation on economic activity is directly, and non-linearly, related to the level of tax rates.

- By the same token, for a given level of initial tax rate, larger changes in a taxes have a larger effect on output.

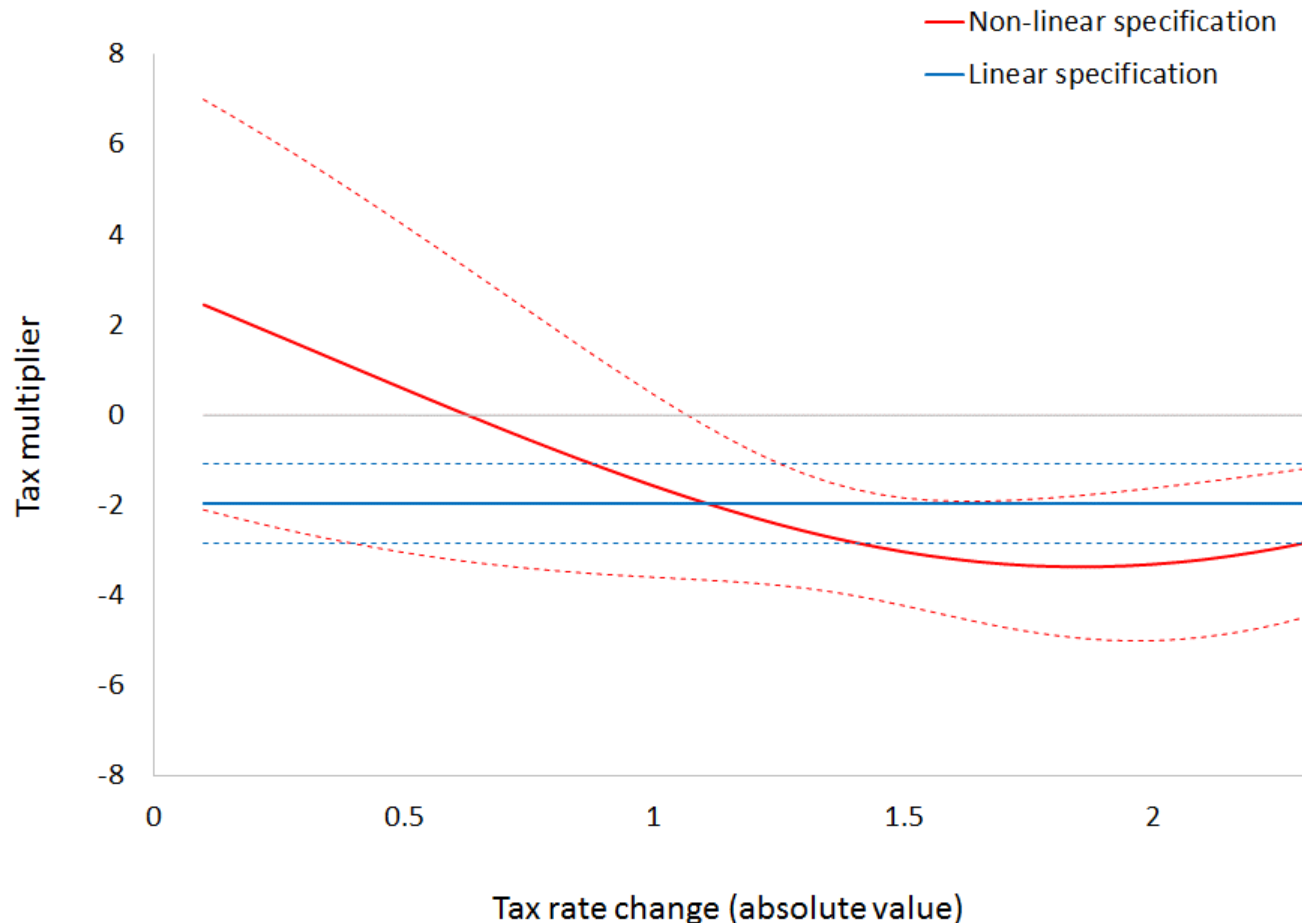
# The non-linear effect of tax changes on output

- 1. LR-multipliers for different levels of initial tax rates



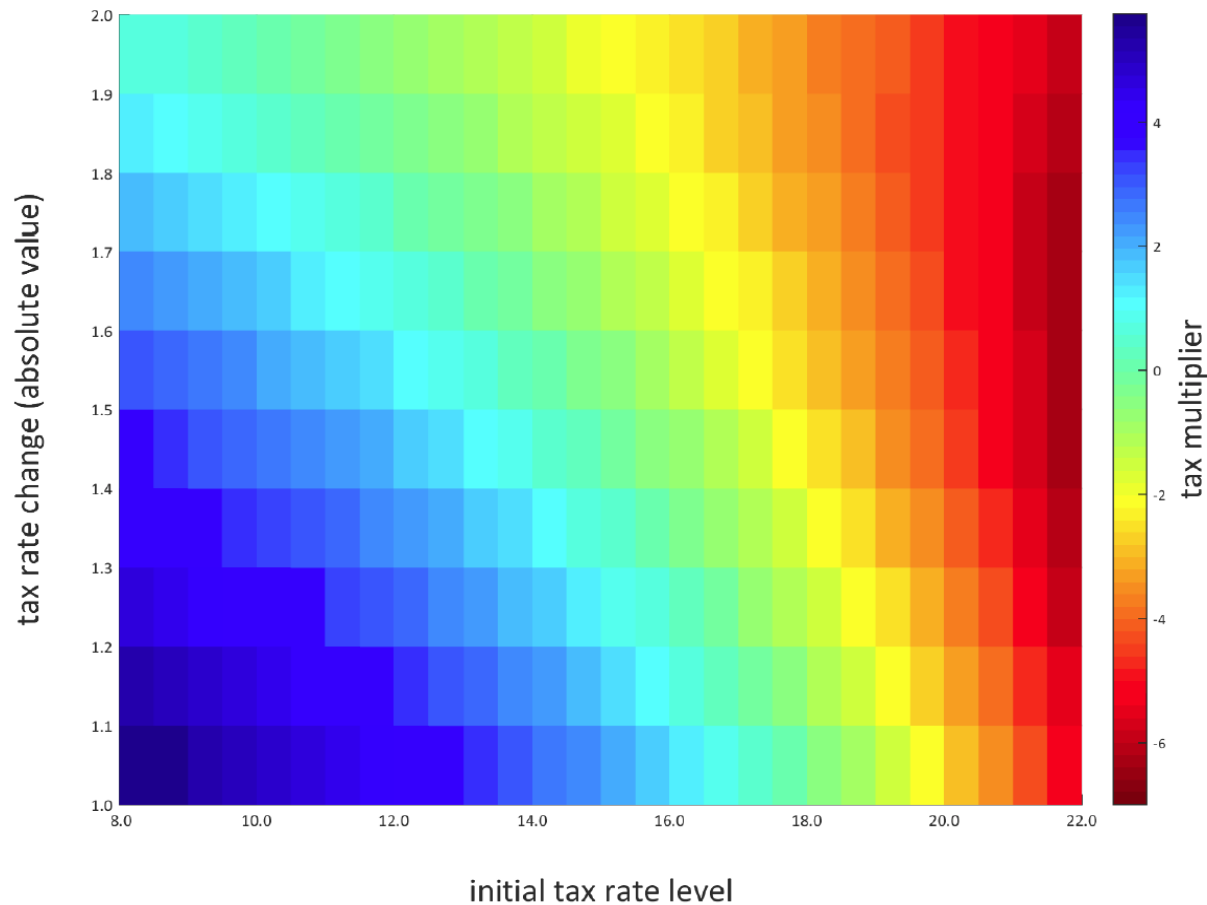
# The non-linear effect of tax changes on output

- 2. LR-multipliers for tax rate changes of different sizes (including quadratic and cube terms)



# The non-linear effect of tax changes on output

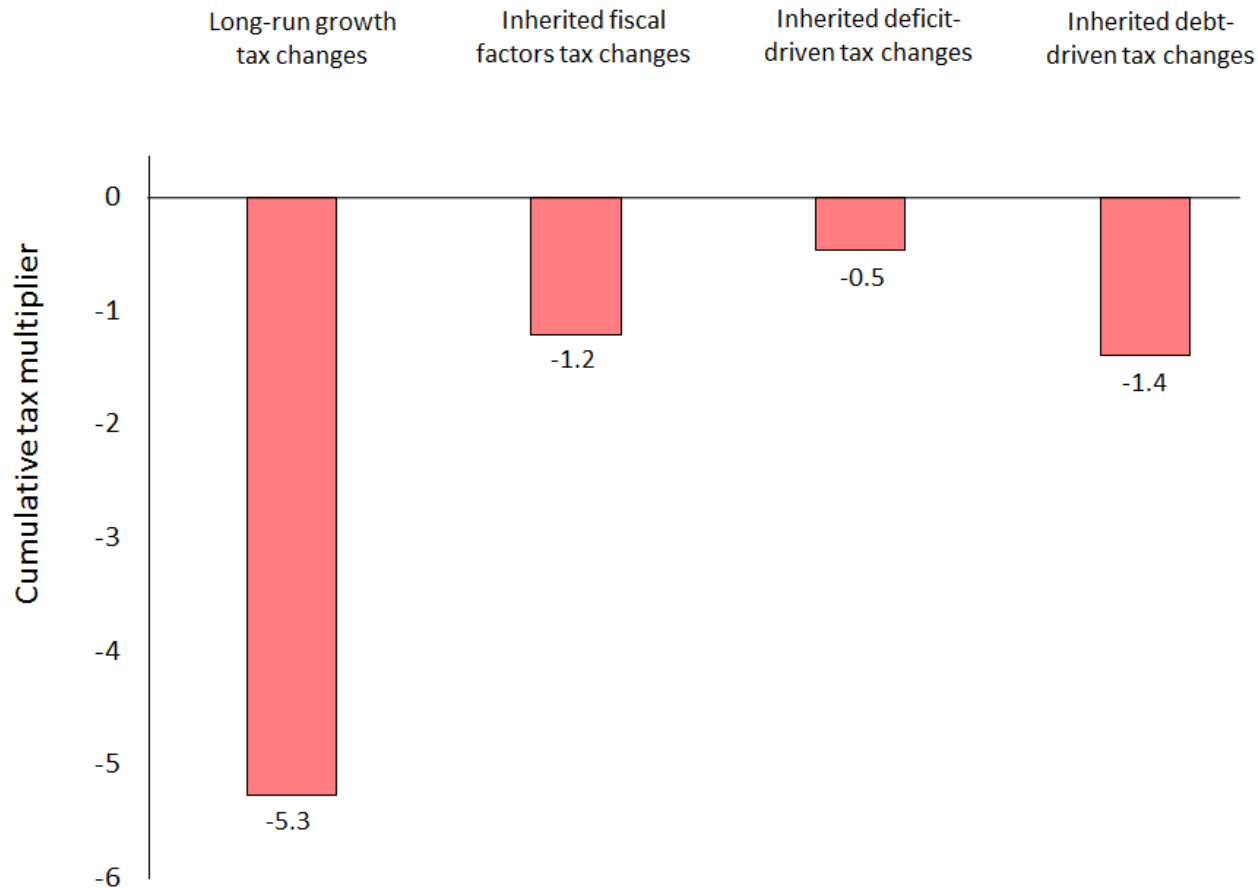
- 3. LR-multipliers for different initial levels of tax rates and size of tax changes





# Non-linearities can explain differential tax multipliers

- Recall differential effects of exogenous tax changes (LR-multipliers):



# Non-linearities can explain differential tax multipliers

- Median test comparisons of initial tax rate and size of tax change

Panel A. Long-run growth versus inherited fiscal factor tax changes

	Long-run growth	Inherited fiscal factors	Difference
	(1)	(2)	(1) - (2)
Initial tax rate	21	19	2**
Size of tax change	1	1	0

Long-run changes have higher initial tax rates than inherited fiscal factors

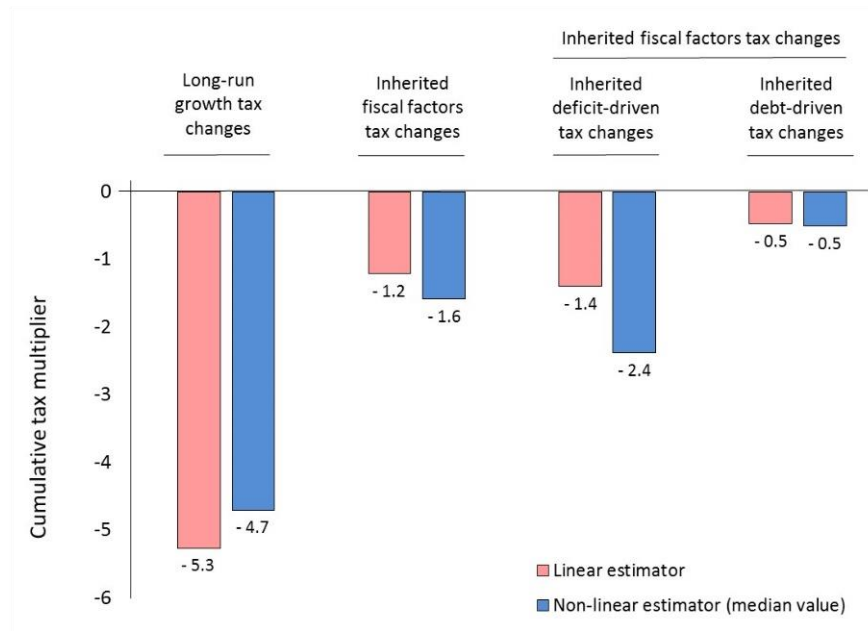
Panel B. Inherited deficit- versus debt- driven tax changes

	Debt-driven	Deficit-driven	Difference
	(1)	(2)	(1) - (2)
Initial tax rate	19	18.5	0.5
Size of tax change	2	1	1**

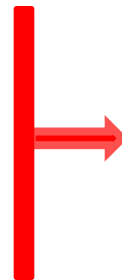
Debt-driven changes have larger size of tax changes than deficit-driven changes

# Non-linearities can explain differential tax multipliers

- Moreover...



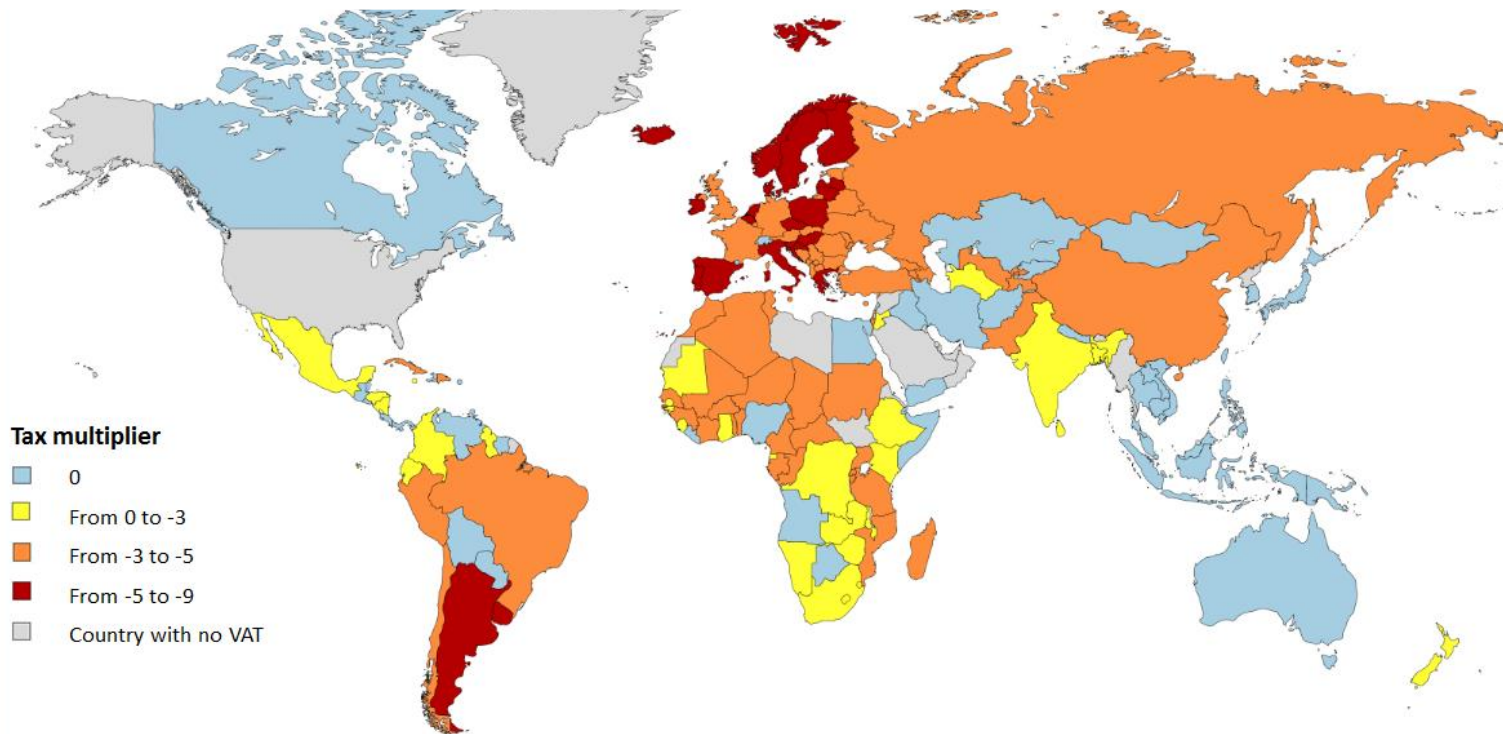
- (i) non-linear arguments  
+
- (ii) differences in initial tax rate and/or size of tax change



Explain the ex-ante “puzzling” differences in tax multipliers of different types of exogenous tax changes

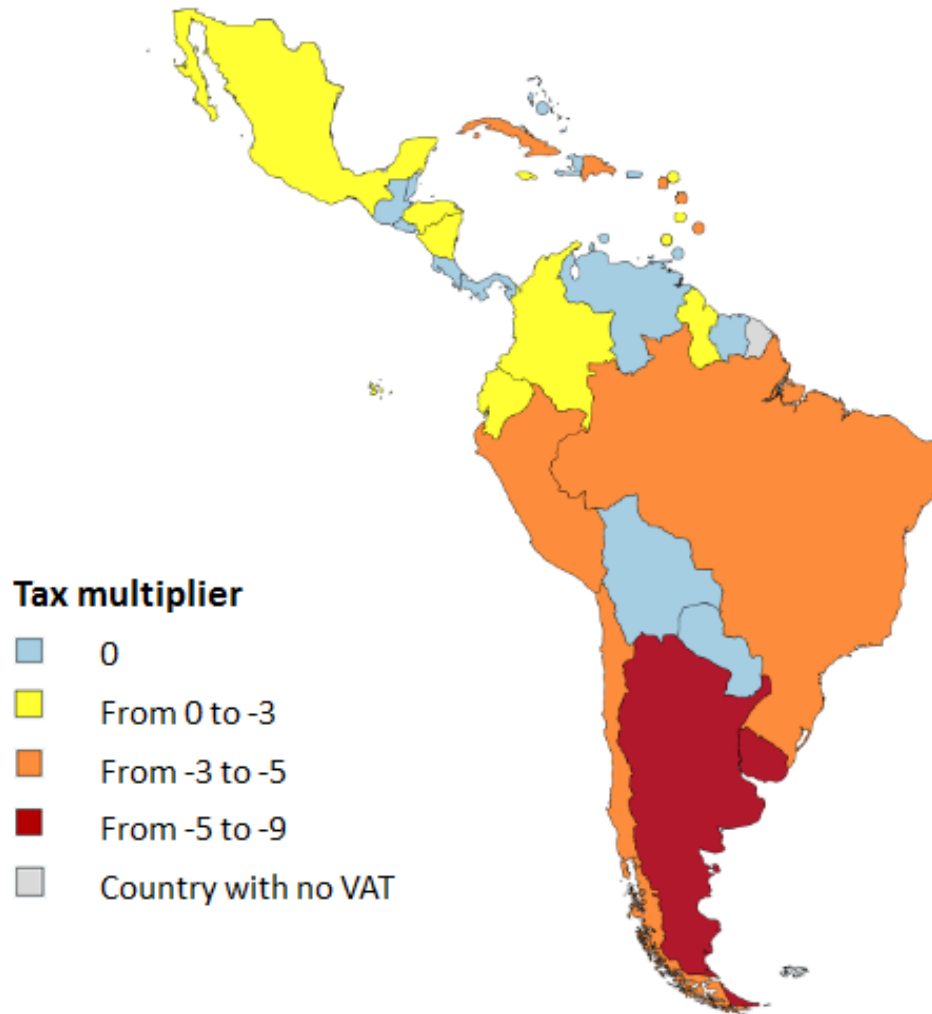
# In Summary...

- The impact of tax changes on output is highly non-linear. The effect is larger (in absolute terms) (i) the higher is the initial level of tax rate and (ii) the larger is the size of the tax rate change.
- Estimating tax multipliers involve much more than “academic debates” and have critical practical implications



# In Summary...

- Our estimates for the region show a quite heterogeneous response to tax shocks:



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- The impact of tax changes on output is highly non-linear. The effect is larger (in absolute terms) (i) the higher is the initial level of tax rate and (ii) the larger is the size of the tax rate change.
- Estimating tax multipliers involve much more than “academic debates” and have critical practical implications

5%	13%	14%	19%	20%	27%
$\Delta 1\text{pp} \rightarrow \text{No } \Delta\text{GDP}$	$\Delta 1\text{pp} \rightarrow \text{No } \Delta\text{GDP}$	$\Delta 1\text{pp} \rightarrow \Delta\text{GDP}$	$\Delta 1\text{pp} \rightarrow \Delta\text{GDP}$	$\Delta 1\text{pp} \rightarrow \Delta\text{GDP}$	$\Delta 1\text{pp} \rightarrow \Delta\text{GDP}$
$\Delta 2\text{pp} \rightarrow \text{No } \Delta\text{GDP}$	$\Delta 2\text{pp} \rightarrow \Delta\text{GDP}$	$\Delta 2\text{pp} \rightarrow \Delta\text{GDP}$	$\Delta 2\text{pp} \rightarrow \Delta\text{GDP}$	$\Delta 2\text{pp} \rightarrow \Delta\text{GDP}$	$\Delta 2\text{pp} \rightarrow \Delta\text{GDP}$

Paraguay (10%)  
Guatemala (12%)  
Costa Rica (13%)

Ecuador (14%)  
Colombia (16%)  
Peru (18%)

Argentina (21%)  
Uruguay (22%)  
Greece (24%)

## Example for Costa Rica:

$\Delta\text{VAT} = 2\text{pp}$   
 $\rightarrow \Delta\text{GDP} \approx 0$

## Example for Colombia:

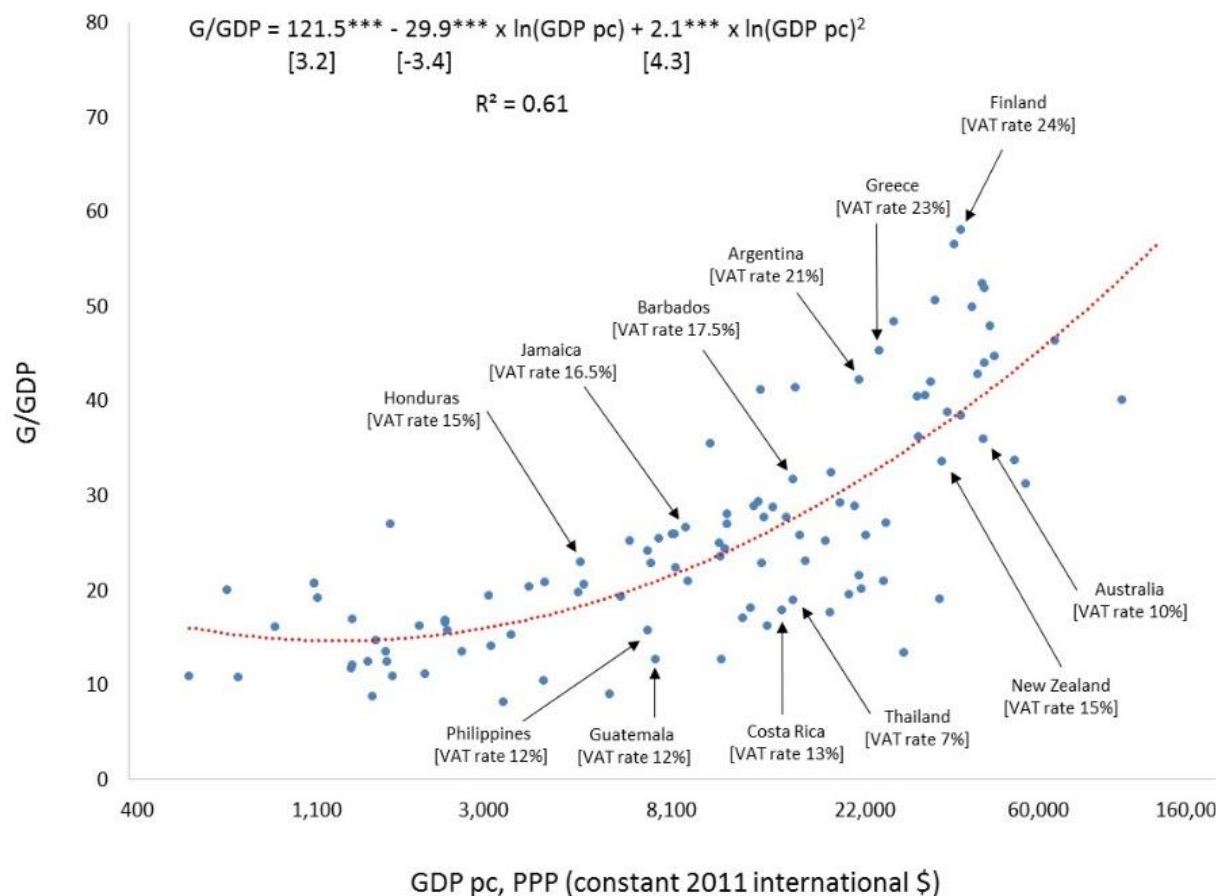
$\Delta\text{VAT} = 2\text{pp}$   
 $\rightarrow \Delta\text{GDP} = -1.7\%$

## Example for Greece:

$\Delta\text{VAT} = 1\text{pp}$  (June 2016,  
from 23% to 24%)  
 $\rightarrow \Delta\text{GDP} = -2\%$

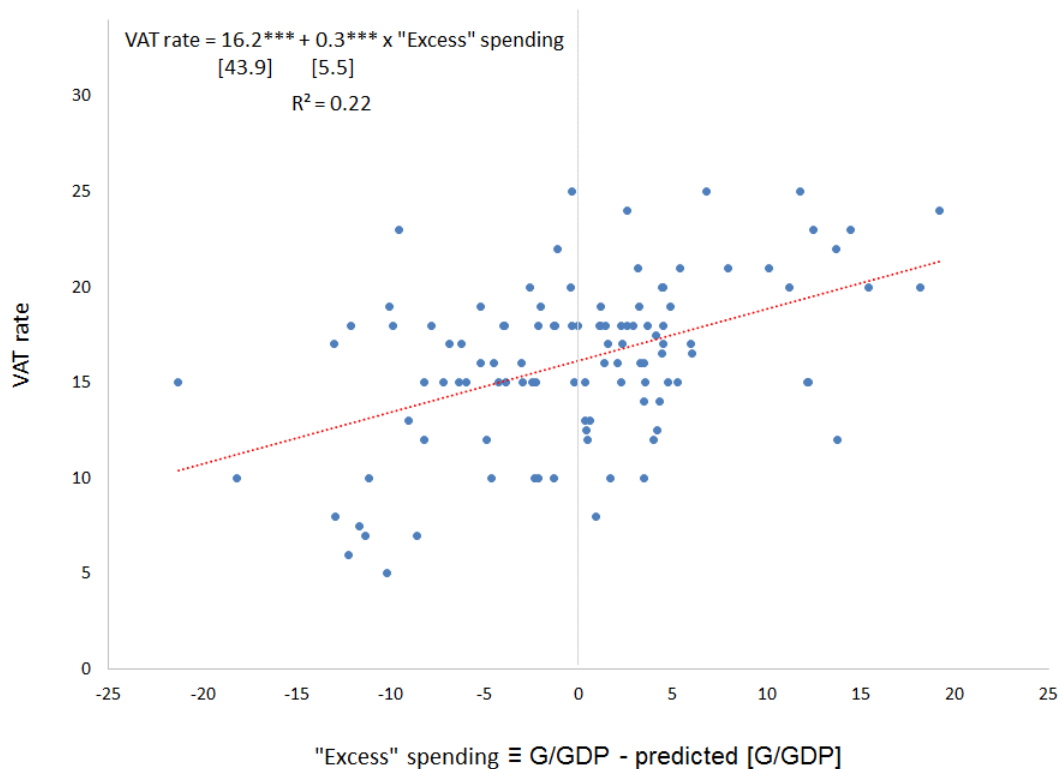
# Policy implications in action I: On the size of the government and economic development

- Relationship between GDP per capita and the size of the government spending with respect to GDP:



# Policy implications in action I: On the size of the government and economic development

- Relationship between “excess” spending and VAT rate:



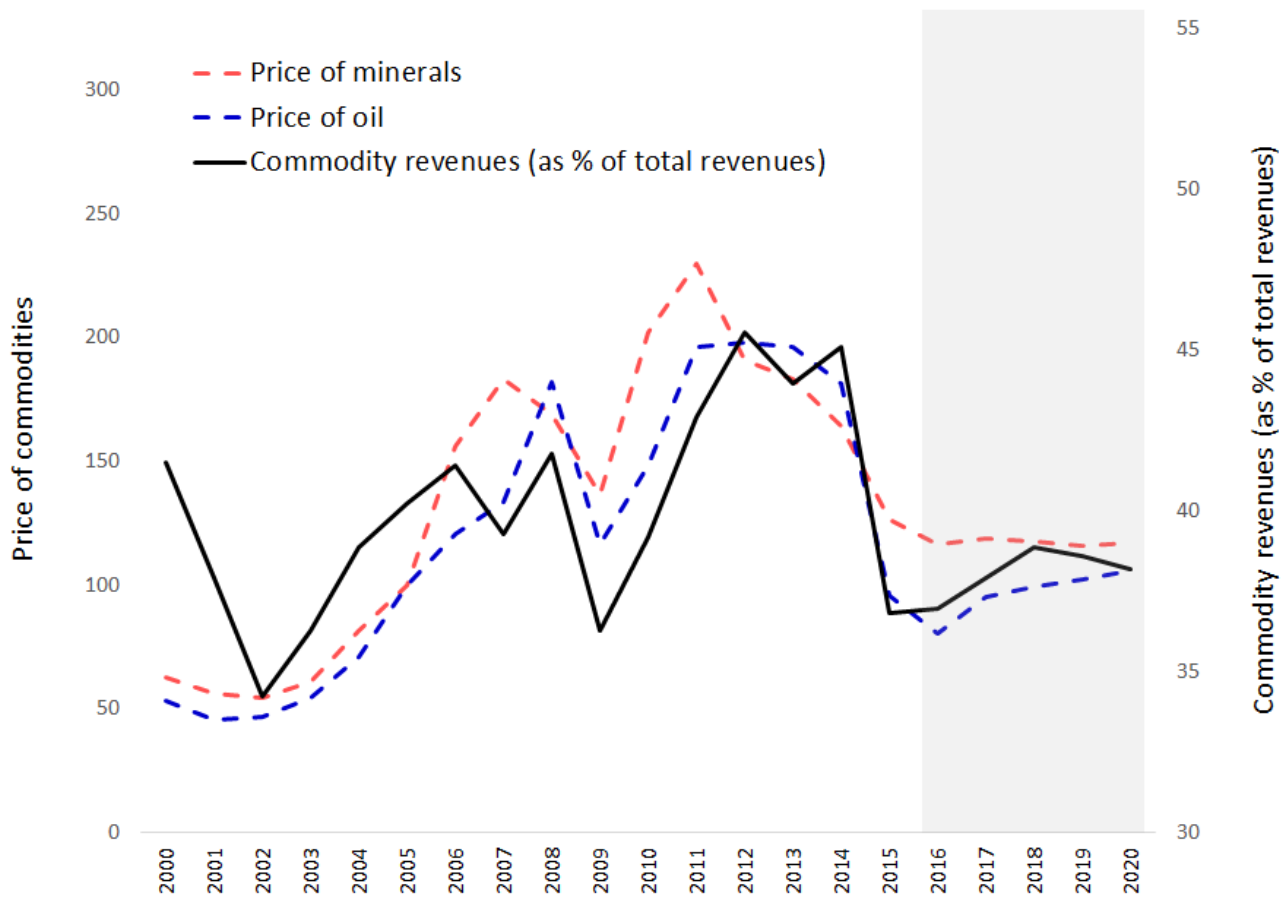
- Countries like Guatemala may be able to “catch up” to a more typical (i.e., larger) provision of public goods by increasing the VAT rate. Critically, the latter will not harm economic activity.

- This is “in line” with August 26<sup>th</sup>, 2016, Article IV Consultation for Guatemala.



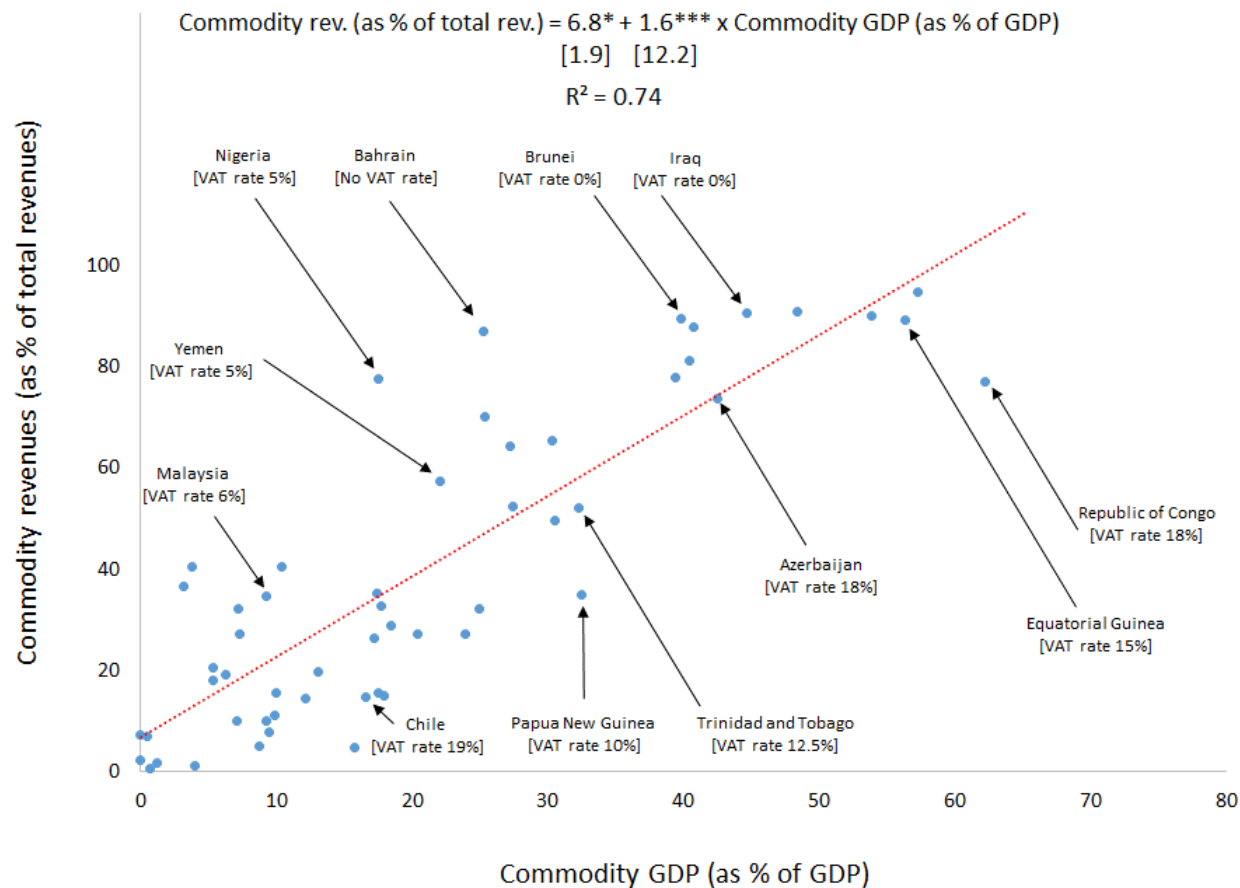
# Policy implications in action II: On revenue mobilization in commodity dependent countries

- Relationship fiscal commodity revenues and price of commodities:



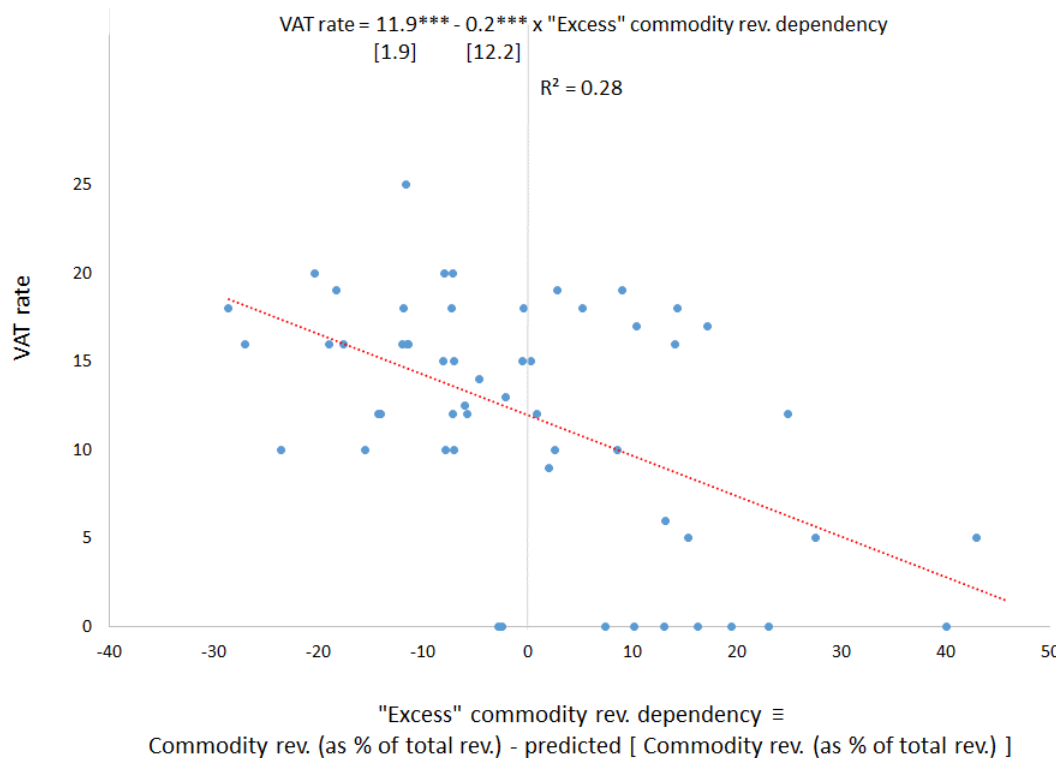
# Policy implications in action II: On revenue mobilization in commodity dependent countries

- Relationship between Commodity GDP (as % of GDP) and Commodity revenues (as % of total revenues).



# Policy implications in action II: On revenue mobilization in commodity dependent countries

- Relationship between "Excess" commodity revenue dependency and VAT rate:



- Countries like Nigeria could quickly mobilize non-commodity revenues by increasing the VAT rate. Critically, the later will not harm economic activity.

- This is "in line" with March 30<sup>th</sup>, 2016, Article IV Consultation for Nigeria.

# Policy implications in action III: Implications for Debt Sustainability Analysis (DSA)

- **Most basic equation in DSA:**

$$d_{t+h} = \frac{1+i}{1+g_{t+h}} d_{t+h-1} - (r_{t+h} - s_{t+h}),$$

where  $g$  is assumed to be exogenous and not endogenously determined by changes in tax policy.

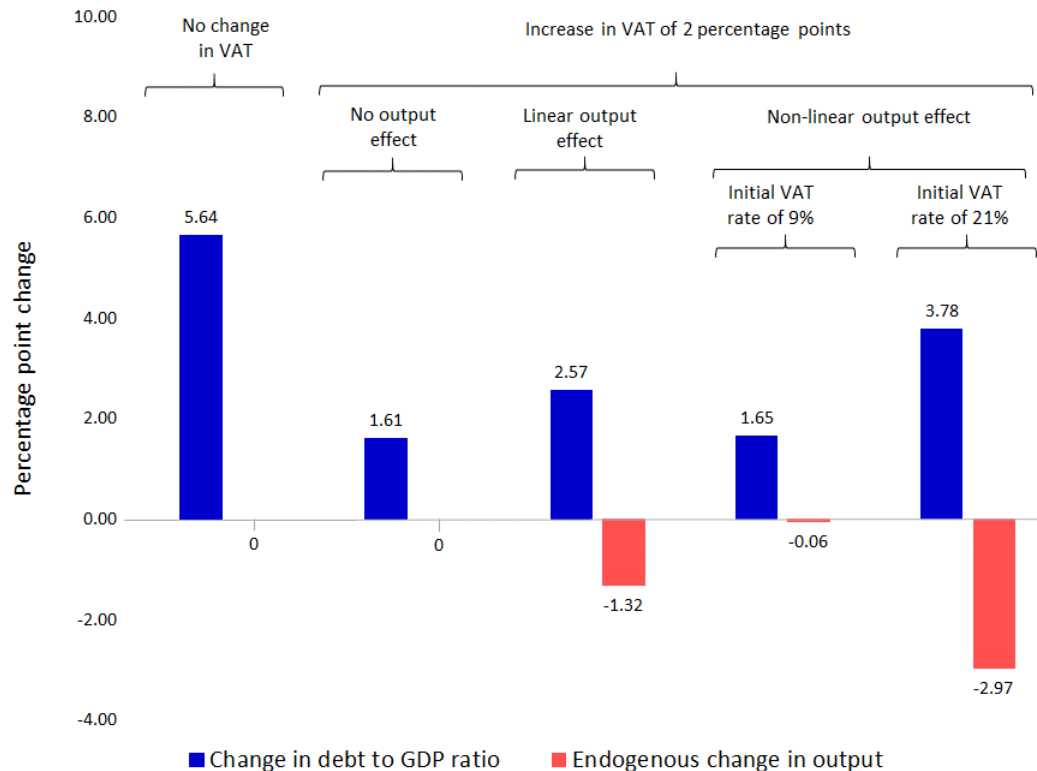
- Given our insight about the response of output to a tax change and non-linear relationship, this basic equation should internalize such endogenous response.
- We use a very simple “model” extension (back of the envelope type):

$$R_t = \text{tax rate}_t \times Y_t,$$

$$g_{t+h} = \bar{g} + \frac{\partial g_{t+h}}{\partial \text{tax rate}_t},$$

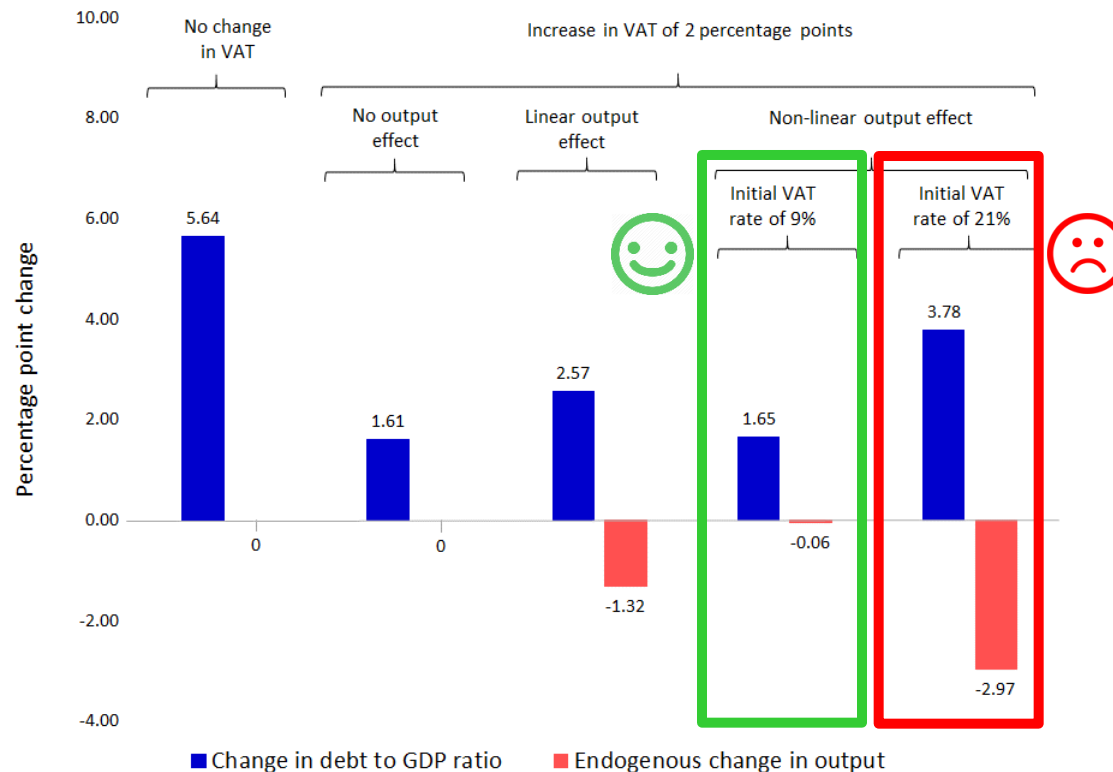
# Policy implications in action III: Implications for Debt Sustainability Analysis (DSA)

- Let's work on an example to explore the relevance of our arguments on DSA.
- Initial set of values:  $d = 0.5$  ;  $\bar{g} = 0.02$  ;  $r - s = -0.03$
- Change in debt to GDP ratio and cumulative in output to alternative changes in VAT rate and under different model assumptions. Two years after the tax shock:



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**Thank You**